

Breaker-induced Surf Zone Radiance

Rob Holman
COAS-OSU
104 Ocean Admin Bldg
Corvallis, OR 97331-5503
phone: (541) 737-2914 fax: (541) 737-2064 email: holman@coas.oregonstate.edu

Award #: N00014-10-10046
<http://cil-www.coas.oregonstate.edu:8080>

LONG-TERM GOAL

The overall goal of this work is to develop a predictive relationship between surf zone hydrodynamic properties and radiance measured from overhead EO sensors. The main focus is on the dynamics of strongly-reflective bubbles and aeration caused by breaking waves, with a secondary focus on the optical properties of un-aerated water. The work has two applications: determination of the probability of clear (un-aerated) water glimpses through which bottom targets could be observed, and development of an optics-based proxy for breaking wave dissipation.

OBJECTIVES

Our objectives in the first year were: a) to collect an extensive data set of coupled EO and base hydrodynamic observations to constrain radiance climatology on a typical (US East Coast) beach, and b) to collect detailed EO observations during the September, 2010, Surf Zone Optics field experiment to compare to detailed measurements of in-situ optical and fluid properties in an active surf zone environment.

APPROACH

Our sampling is based on the Duck, NC, Argus Station, a collection of 10 cameras situated on the FRF Tower at the Duck Field Research Facility. Argus provides on-line EO coverage of an approximately 1000 m. (alongshore) by 500 m. (cross-shore) nearshore region centered on the FRF pier. Beginning in 2009, hourly time series data were collected over the sample region, but with a 5 m. (cross-shore) by 10 m. (alongshore) resolution. A variety of products are created from these data including min, mean and max intensities at every pixel as well as histograms showing the probability of intensities as a function of cross-shore position, depth and wave conditions (for example, Figure 1). In the upcoming year, we will be collaborating with Jim Kirby to integrate our extensive observations with models of breaker-induced bubble populations.

While the above work provides climatological statistics of surf zone radiance under the full range of wave and bathymetric conditions, it was carried out in the absence of in-situ ground truth measurements of the relevant geophysical quantities like wave energy, dissipation and in-situ optical

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2010		2. REPORT TYPE		3. DATES COVERED 00-00-2010 to 00-00-2010	
4. TITLE AND SUBTITLE Breaker-induced Surf Zone Radiance				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Oregon State University,COAS-OSU,104 Ocean Admin Bldg,Corvallis,OR,97331-5503				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 3	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

properties. To provide this link, a two-week field experiment was carried out at Duck, NC, during which enhanced in situ sampling of hydrodynamic and water optical properties was carried out.

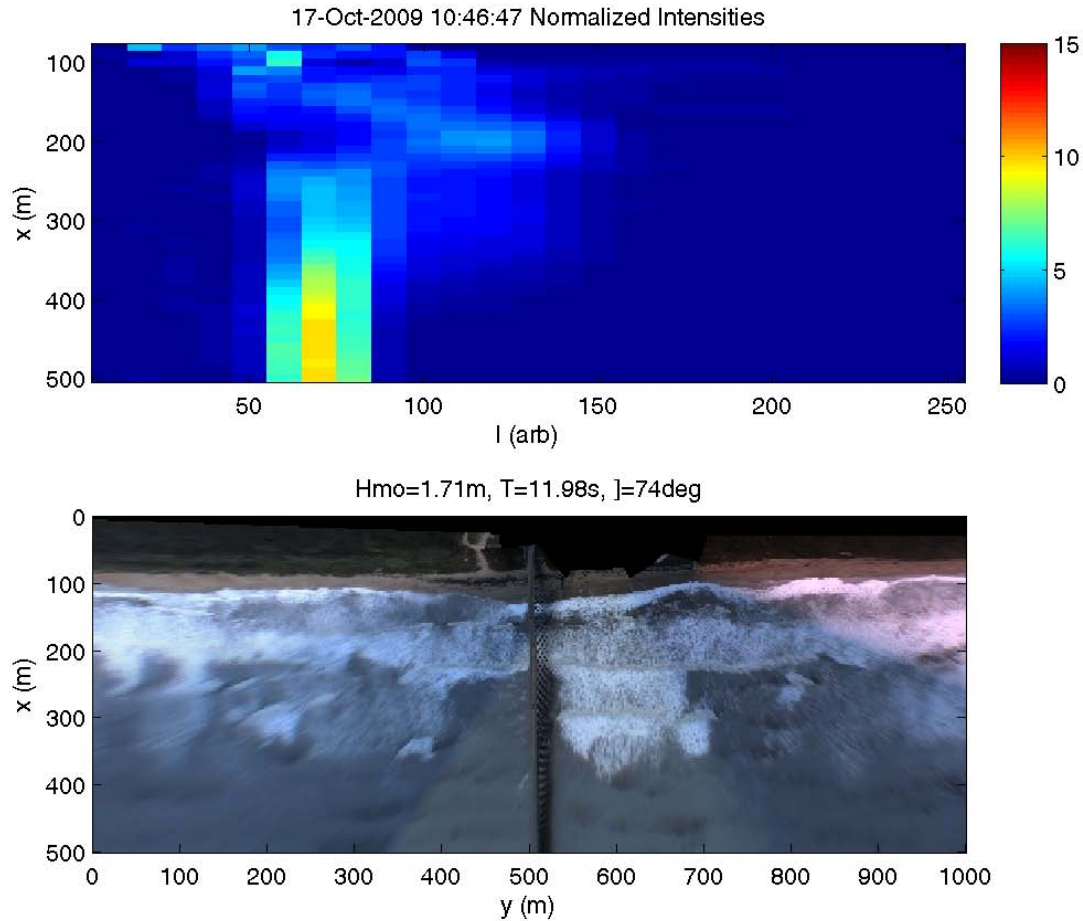


Figure 1. *Merged snapshot of the Duck surf zone during a moderate event ($H_s = 1.71$ m.; lower panel). Time series were collected from throughout this domain. The upper panel shows histograms of measured relative intensity (x-axis) versus cross-shore position (averaging over the full alongshore extent of the sampling domain). Offshore background measured intensities around 70, give way to higher and wider-ranging intensities in the regions of depth-induced breaking, especially over sand bars and $x = 315$ m. and 200 m., and at the shoreline, $x \sim 100$ m.*

WORK COMPLETED

Hourly data have now been collected for ~ 1 year, documenting the natural statistics of surf zone aeration, and appropriate predictive statistics will be developed. A number of products are being investigated, for example, the ‘brightest’ image showing the image of the maximum brightness achieved by each pixel over the 10-minute sampling period (Figure 2). We have also completed the Surf Zone Optics field experiment, 7-17 September 2010, during which enhanced Argus sampling was collected to compare to in-situ measurements of hydrodynamics and water optical properties collected by WHOI, Wet Labs, Arete, UW-APL and the FRF.



Figure 2. Example ‘brightest’ image, showing the maximum intensity during the 10-minute collection period. Results from five cameras have been merged into a rectified (geospatial) view. Brightest images allow easy separation of depth-induced breaking (contiguous white patches) from whitecapping (white short length-scale clutter). These figures allow determination of whether the positions of various Surf Zone Optics in-situ sensors, show by colored dots, were ever in the surf zone during any particular data run.

RESULTS

Work has focused on data collection and early analysis.

IMPACT/APPLICATION

This results from this work and from understanding the link between surf zone hydrodynamics and the optical properties will be significant in two ways. In the forward model sense, we will develop a predictive model of the expected EO reflectance properties due to water column aeration that will aid in determining the likelihood of seeing into the water column to detect submerged objects. In the inverse direction, this understanding should allow an invertible link between observed radiance measurements and causative hydrodynamic properties such as incident wave dissipation that, in turn, is the primary driver of nearshore circulation.

RELATED PROJECTS

1. DARLA MURI – Data Assimilation and Remote-sensing for Littoral Applications (joint with UW-APL)
2. Joint work with Dr. Todd Holland, NRL-SSC on BWLite and SUAV applications
3. Numerous collaborations with the USACE Field Research Facility including Morphos and XBeach testing and operations.